REMARKS

Claims 1-33 were pending, including independent Claims 1, 8, 15 and 27. After entry of the amendment set forth above, the same-numbered Claims 1-33 will be pending, including independent Claims 1, 8, 15 and 27.

No new matter is added by the amendments set forth above. The amendments to Claims 1 and 8 are supported by Claims 2 and 9 as originally filed, respectively. The amendments to Claim 15 are supported, for example, by Claim 27 as originally filed. The amendments to Claims 2 and 9 are supported by the preferred embodiments illustrated in figures 4-6, as described for example in paragraph 59 bridging pages 4-5 of the published application.

Claim Objections

In section 1 of the current Office Action, the examiner objects to the element labeling employed in Claims 2-7 and 9-13. The objection is addressed by deleting labeling that is not common to all claims.

Rejection of Claims 1-4, 7-10, 13 and 14 under 35 U.S.C. §102(b) over Cluff

In section 3 of the current Office Action, the examiner rejects claims 1-4, 7-10, 13 and 14 as anticipated by Cluff. In response, the subject matter of Claims 2 and 9 (as filed) has been incorporated into independent Claims 1 and 8, respectively. Consequently, the examiner's rejections of Claims 2-4, 7, 9-10, 13 and 14 now effectively apply to Claims 1, 3-4, 7, 8, 10, 13 and 14, respectively, and such rejections are respectfully traversed for reasons set forth below.

In the first paragraph of page 4 of the current Office Action, the examiner asserts that "the liquid bath (34) in Figure 1, is a coolant that provides primary cooling of the conversion device (42) through thermal contact with an exterior of the support structure (32)(col.3; lines: 21-26)." The Applicant respectfully disagrees. The col. 3 citation refers to Figure 22, which is a perspective view of a parabolic reflector directing sun to photovoltaics. It may be seen that the parabolic reflector directs the incoming light to "water cooled photovoltaic cells 51. The cells are cooled by water conducting copper pipes 107 positioned within the V-shaped trough 106, as shown" (Cluff, col. 7 line 54 - col. 8 line 13, underlining added for emphasis).

Cluff teaches mounting the solar collectors on a platform that floats on a liquid pond (*e.g.*, item 32 of Figure 7), and also floating collecting pontoons directly on a pond (*e.g.*, Figs. 13-17 as described col. 6 line 40 - col. 7 line 17), but does not describe using the pond liquid for cooling. As to the former, support on a

floating platform clearly does not permit cooling as required by Claims 1 and 8, as currently amended. As to the latter, the relevant photovoltaic details are shown in figures 15 and 16 of Cluff, where it may be seen that both fail to suggest cooling "through thermal contact with an exterior of the support structure" as required by Claim 1 (and comparably for Claim 8), as presently amended.

Cluff simply does not disclose, teach or fairly suggest that the supporting liquid (or "pond") should provide cooling for photovoltaics. Cluff teaches photovoltaic cooling techniques, such as illustrated in Figures 10-12 and described at col. 6 lines 30-39 (see also col. 5 lines 30-45, especially lines 37-41). The examiner will see that all of those techniques require conveying liquid near the photovoltaic devices via tubes. For Cluff, the pond merely supports the collector, and is not suggested to be used for cooling. Accordingly, Claims 1 and 8 as currently amended, as well as claims 2-7 and 9-14 that properly depend from Claims 1 and 8, respectively, are not anticipated by Cluff. It is respectfully submitted that each of Claims 1-14 are accordingly properly allowable over Cluff.

The remarks below demonstrate that Claims 2-4, 7, 9-10 and 13-14 each require at least one further feature that is not disclosed, taught or fairly suggested by Cluff.

Claim 2, as presently amended, require (underlining added for emphasis): "the photovoltaic mounting is on an inside of an exterior wall that in operation is in contact with (d) the liquid bath at a point directly transverse a point of the mounting." Claim 9 has generally comparable requirements. Figures 15-16 and 22-24 of Cluff show photovoltaic mounting, none of which is as required by either of Claims 2 or 9.

Claim 3 requires (underlining added for emphasis): "the support structure ... is disposed in contact with a liquid bath in an array of support structures, substantially abutting adjacent support structures." These requirements are contrary to the teaching of Cluff that the support structures must be spaced apart to avoid interference. Both of the figures of Cluff that are relevant, Figs. 13 and 14, illustrate substantial space maintained between the panels 65 (of collectors 61), as is described explicitly at col. 6 lines 56-60. Such spacing is contrary to the requirements set forth in Claim 3, and to comparable requirements in Claim 10.

Claims 4 and 11 require that the lens bends light at an average non-zero angle. In most lenses, including those suggested by both Cluff and Genequand, light enters perpendicularly to the lens and focuses at a point that is directly behind the center of the lens. A line from the center of symmetry of the lens to the focal point defines an axis that is the average angle of the light transmitted by the lens. Figures 2, 5 and 15 of Cluff, and the figure of Genequand, all show that the incoming light is perpendicular to the lens, and that the

transmitted light focus is on an axis perpendicular to the center of the lens; thus the average transmitted light has a zero angle with respect to the incoming light. The Applicant, however, has found it advantageous to require a non-zero angle between the incoming light and the average outgoing light. This may be seen in Figs. 4-6 by the fact that the focus is clearly not on an axis that is perpendicular to a center of the lens. Of course, the claim language is more precise, but it is hoped that the description above clarifies the nature of a "substantially non-zero angle" of the average of light passing through the lens. It should be clear that neither Cluff nor Genequand teach, disclose or fairly suggest such a requirement for a solar collection lens.

Claim 7 and 13 include geometric requirements which, in some embodiments of the Applicant's invention, facilitate the goal of successfully cooling the photovoltaic devices passively to the liquid of the supporting pond. By keeping the position of the photovoltaic low -- below the level of the water over a substantial portion of the angular operating range of the collectors, as required by Claims 7 and 13 -- the photovoltaic may readily be very closely coupled, thermally, to the pond liquid to effect cooling. As may be seen in Figs 4-6, the nonzero average light bending required by Claims 4 and 11 works with some pontoon shapes to permits keeping the photovoltaics low in the liquid bath for effective cooling. None of the photovoltaics of Cluff is shown or described as being below a surface plane of the supporting bath.

Claim 14 requires one sensor in each pontoon. Cluff, to the contrary, expressly suggests using only one sensor per array of pontoons for sensing sun altitude, and one sensor per array for sensing sun azimuth (Cluff, col. 4 line 62 - col. 5 line 2).

The foregoing remarks demonstrate not only that Claims 1 and 8, as presently amended, are properly allowable over the cited prior art, but that Claims 2-4, 7, 9-10 and 13-14 are distinguished over Cluff not only by virtue of properly depending from a properly allowable independent claim, but are each further distinguished by at least one additional limitation. Claims 5-6 and 12 are properly allowable at least by virtue of properly depending from Claim 1 or Claim 8.

Rejection of Claims 15-32 under 35 U.S.C. §102(b) over Genequand

In section 4 of the current Office Action, the examiner rejects Claims 15-32 as anticipated by Genequand. Useful amendments have been made to independent apparatus Claim 15 to clarify distinctions over Genequand. The present amendment of Claim 15 includes three parts: a nonlimiting proposed use section in the preamble; a clarification that (as originally intended) it is the same target over which each of the subregions distributes light uniformly; and a clarification that it is the area of the target that is finite. This

latter requirement particularly distinguishes the many lenses, including the lens described by Genequand, which focuses parallel incoming light to a single point. Remarks below will demonstrate that Claim 15 is well distinguished over any such singe-point focus lens.

Claim 15 is the primary subject of the remarks set forth immediately below. However, it will be seen that related independent method Claim 27, as originally filed, already included substantially similar details as are relied upon in Claim 15. Distinctions of Claim 15, as presently amended, over Genequand are described in the remarks set forth below. Claim 27 includes requirements that are generally similar to those of Claim 15 that are remarked upon below. In view of the remarks set forth below in respect of Claim 15, those related requirements of Claim 27 will readily be seen to distinguish Claim 27 from Genequand.

The preamble defines "an overall light-receiving region" which includes a plurality of "light-receiving subregions." Examples of overall optical regions having a plurality of subregions include a multi-faceted jewel, and a fly's eye. Many lenses, including that of Genequand, have subregions ... in theory, in fact, all lenses may be said to have subregions. However, the facets (subregions) of Claims 1 and 8 have a very particular requirement, as will be seen.

The simplest example of a "predefined relative density distribution" is a uniform density distribution, such as would be expected of sunlight impinging on ordinary solar collectors. The most common angle of sunlight entering a solar collection lens is "straight in," that is, perpendicular to some plane representative of the lens. However, both terms are set forth more broadly, because the principle of the claim may be used to achieve relatively uniform light distribution of a target in the presence of shadowing even if the predefined density distribution is nonuniform, and/or the light has a non-zero angle to a representative plane of the lens, and/or the entering light rays are not substantially parallel, if the entering angles and relative distribution are known. Because the simplest example is common to typical solar collectors (*i.e.*, the received light is uniformly distributed, and enters perpendicularly to the lens), these limitations will often be satisfied.

Because lenses having the requirements set forth above need not be unusual, the particular requirements imposed on each of the plurality of subregions will in many cases provide the most distinction. Claim 15, as currently amended, recites in part (underlining added for emphasis and reference): "each subregion is configured to disperse the incoming subregion light [*i.e.*, the light entering such "each" subregion with predefined relative density and along predefined paths] <u>with substantially uniform density over an entirety of a same corresponding finite area energy collection device</u>."

It is acknowledged that many lenses, especially typical concentrating photovoltaic lenses, commonly distribute light uniformly over a finite target region. However, the Applicant is unaware of any other lens designed to provide a plurality of subregions that each individually distribute their light uniformly over a target region. It may be useful, for purposes of searching for relevant prior art, to understand the motivation for such a design, which is to provide tolerance of partial shading of the lens (shadow tolerance). Because other uses are certainly possible for such a lens, shadow tolerance is only a suggested use, and is accordingly included only as a non-limiting suggested use in the preamble. Nonetheless, the claim requirements may be more readily understood by considering how they may enable the deleterious effects of partial shading to be reduced.

In some circumstances, the lens of the Applicant's solar collectors becomes partially shadowed, and with ordinary lenses this would result in a very nonuniform light distribution on the target photovoltaic device. The efficiency of photovoltaic cells, particularly those designed for concentrated sunlight, falls off precipitously when the light distribution over the cell becomes significantly nonuniform. When an ordinary point-focus lens is partly shadowed, the target photovoltaic will be correspondingly partly shadowed, resulting in substantial light nonuniformity and very poor efficiency. If, however, a lens has many subregions that each distribute the light uniformly over the whole target, then the nonuniformity on the target need not correspond to the nonuniformity on the whole lens. Only certain subregions as are partly shaded at a particular time (those across which a shadow line falls) have nonuniform incoming illumination, so only those certain subregions will contribute to non-uniform light distribution on the target photovoltaic. All other subregions receive light uniformly, either in small quantity (if fully shaded) or in large quantity (if fully illuminated), and thus all other subregions would not contribute to nonuniform target light distribution.

Point Focus Lenses: Lenses having a single focal point (for plane wave or parallel incoming light) are believed to be geometrically incapable of including a plurality of subregions that each distribute their light uniformly over a same finite target region, as required by Claim 15. The figure of Genequand demonstrates why this is so: as shown there (and by definition of "single focal point), all light entering the lens is bent so that it tries to go through the focal point. Any finite region that is to receive light from the lens must therefore not be in the focal plane, else it would receive only an infinitesimal point of light. However, when the target region is not in the focal plane, it will be seen that light entering a particular region of the lens must strike the target region at a particular region that corresponds to the source location. Indeed, this is why lens optics work to convey images. As shown by the arrows representing light in the Genequand figure, light from the

left side of the lens is directed to the left side of the target, while light from the right side of the lens is directed to the right side of the target, and so on. The correspondence between the incoming light and the light hitting the target is one-to-one: for any given region, whether the whole target or part of it, there is only one corresponding region of the lens that distributes its received light to such given target region. This, of course, is directly contrary to the requirement for a plurality of subregions that each distribute light (uniformly) over a same target region.

The lens of Genequand, like many other lenses including those of Cluff, is a "point focus lens" (see abstract "same focal point;" col. 2 lines 6-23, cited by the examiner: "in order that all slats reflect energy on the same focal point;" and also *id.*, the slats are arranged "so as to reflect incident solar rays onto the same focus as the focus of the Fresnel lens;" and elsewhere; underlining added for emphasis). Thus, it cannot satisfy the requirements of Claim 15.

It may be confusing to consider that any and all subregions of single focal point lenses focus their incoming light to a same point. It sounds similar to "subregions distributing light over a same region." However, it is not similar, because a point is infinitesimal, and is not a region having finite area. Accordingly, though the subregions in Genequand focus light on the same point, this is not at all the same as distributing light uniformly over a same region. Indeed, "uniform distribution" over a "region," as required by Claim 15, is meaningless if the focus is a single point. Moreover, the limitation to a "finite area" of the target precludes arguments based on a focal "point," and thus further buttresses the distinction of Claim 15, as presently amended, over any single-point focus lens.

In view of the remarks set forth above, it is clear that Claim 15, as presently amended, is well distinguished over Genequand. Genequand has subregions, but those subregions do not satisfy the requirement of Claim 15, particularly those portions of the claim that are set forth and underlined above. Instead, the sole figure of Genequand strongly suggests that the Genequand lens is entirely conventional, with (at most) the light that is incident over the entire lens being distributed over the entire target area. For the purposes of Genequand, imposing a limitation on each of the subregions to distribute light uniformly over "an entirety of" the target would require a drastic change in lens design, including a change from single-point to multiple focuses. Moreover, such design would serve no purpose that is apparent in Genequand, where the tacit assumption appears to be that incoming light is always uniform over the entire lens (*i.e.*, there is no hint of shadowing or other cause of nonuniformity). Without shadowing (or other condition that might benefit

from the multi-focus of the claimed invention, there would be no reason for Genequand to engage in such an arduous design even if the basic concept of a multi-focus lens was known.

The present amendment of Claim 15 has three parts: a nonlimiting proposed use section in the preamble; a clarification that (as originally intended) it is the same target over which each of the subregions distributes light uniformly; and a clarification that it is the area of the target that is finite. In Claim 27, as originally filed, the preamble includes shadow [tolerance] in a description of intended use; element (a) includes "target region having a finite extent;" and element (c) requires the subregions to each distribute their light uniformly over the target region. Thus, original Claim 27 included each aspect that is added or clarified by the present amendments to Claim 15. The examiner will readily see that Claim 27 is well distinguished over Genequand for at least substantially similar reasons as described above in respect to Claim 15. Accordingly, independent Claims 15 and 27 are both properly allowable over the cited prior art, thereby also rendering Claims 16-26 and 28-33 similarly allowable at least by virtue of proper dependency.

Rejection of Claims 5-6 and 11-12 under 35 U.S.C. §103(a) over Cluff in view of Genequand

In section 6 of the current Office Action, the examiner rejects Claims 5-6 and 11-12 as obvious over Cluff in view of Genequand. Claim 5 recites a shadow toleration mechanism, and, as noted in remarks set forth above, it is respectfully submitted that Genequand has no teaching whatsoever in respect of "avoid[ing] substantially non-uniform illumination of operating photovoltaic conversion devices due to" "shadowing that causes substantially non-uniform illumination of the receiving region of the lens." Remarks set forth above also demonstrate that Genequand does not suggest "each subregion is configured to disperse the received light substantially uniformly over an entire surface of at least one corresponding target photovoltaic conversion device," as required by Claim 6. Claim 11 requires "the light delivery axis at a significantly non-zero angle with respect to the incoming light axis." That is contrary to the lens of Genequand, which has a zero angle between the average delivery axis and the light source axis, again as demonstrated by remarks set forth above. Claim 12 is distinguished from Genequand for similar reasons as Claim 6. Thus, features of each of Claims 5-6 and 11-12 that are not disclosed by Cluff are also not suggested or disclosed by Genequand. Accordingly, because Genequand does not remedy the failure of Cluff to suggest cooling to the pond liquid, each of Claims 5-6 and 11-12 is nonobvious over the combination of Cluff and Genequand for at least two different reasons.

In section 7 of the current Office Action, the Examiner rejects Claim 33 as obvious over Genequand in view of Hein. Remarks set forth above in respect of Claims 15 and 27 support a conclusion that Genequand does not teach, disclose or fairly suggest the requirements of Claim 27. Hein does not remedy

that deficiency of Genequand, and accordingly Claim 33 is not rendered obvious by a combination of Genequand and Hein for at least that reason.

Conclusion

It is respectfully submitted that the amendment and remarks set forth above overcome each objection and ground of rejection set forth by the Examiner. As such, the Examiner is respectfully requested to reconsider the application, to withdraw all objections and rejections, and, barring the discovery of new grounds for rejection, to promptly issue a Notice of Allowance of all pending claims.

The Commissioner is authorized to construe this paper as including a petition to extend the period for response by the number of months necessary to make this paper timely filed.

Respectfully submitted,

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